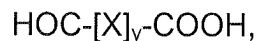


REMARKS

The outstanding Office Action indicates that Claims 1, 3, 4, 6 through 9 and 11 through 15 are pending in the application.

Claim 1 been amended to reflect advantageous embodiments in which the chemical compound having at least one acid group and at least one aldehyde group is a compound of the general chemical formula



where X is a divalent alkylene group which has from 1 to 6 carbon atoms and can be saturated and straight-chain or branched, or a divalent saturated cyclo- or bicycloalkylene group having from 3 to 10 carbon atoms, or a divalent arylene group having from 6 to 10 carbon atoms, where these groups can further bear one or more substituents R which, in addition to hydrogen, can also be alkyl radicals having up to 4 carbon atoms, alkoxy radicals having up to 4 carbon atoms, OH groups, halogens, nitro groups, nitrile groups or mixtures thereof, and where y can be either 0, 1 or 2. Support for this amendment can be found in the Application-as-filed, for example in Claim 3 as-filed. Accordingly, Claim 3 has been canceled, as its subject matter has been incorporated into Claim 1.

Claim 1 has also been amended to reflect advantageous embodiments in which the aqueous solutions contain the inventive reversibly crosslinked cellulose ether as the sole viscosity developer. Support for this amendment can be found in the Application-as-filed, for example on Page 6, lines 9 through 13 and Page 7, lines 16 through 22.

Claim 1 has been amended to reflect advantageous embodiments in which the solvation delay is a minimum of a few seconds. Support for this amendment can be found in the Application-as-filed, for example on Page 2, lines 13 through 14.

Claim 1 has also been amended to remove the extraneous term "first." Support for this amendment can likewise be found in the Application-as-filed.

Claim 11 has been amended to reflect advantageous embodiments in which the cellulose ether is pre-moistened with either 40 to 80 % water or pre-suspended in 30 to 60% organic suspension medium prior to admixing. Support for this amendment can be found in the Application-as-filed, for example on Page 5, lines 7 through 11 and Page 7, lines 16 through 31.

Claim 13 has been canceled in conformance with Claim 1 as-amended.

Claim 14 has been amended to reflect advantageous embodiments in which the cellulose ether is pre-moistened with 40 to 80 % water prior to admixing. Support for this amendment can be found in the Application-as-filed, for example on Page 5, lines 7 through 11 and Page 7, lines 16 through 26.

Claim 15 has been amended to reflect advantageous embodiments in which the cellulose ether is pre-suspended in 30 to 60% organic suspension medium prior to admixing. Support for this amendment can be found in the Application-as-filed, for example on Page 5, lines 7 through 11 and Page 7, line 27 through Page 8, line 9.

Reexamination and reconsideration of this application, withdrawal of all rejections, and formal notification of the allowability of the pending claims are earnestly solicited in light of the remarks which follow.

Section 112 Rejections

Claims 1, 6 through 9 and 11 through 15 stand rejected over the term “chemical compounds containing at least one aldehyde group and at least one acid group.” Without addressing the merits of the rejection and solely to advance prosecution of the above-referenced case, Claim 1 has been amended to incorporate the advantageous embodiment of Claim 3. Accordingly, Applicants respectfully request withdrawal of the foregoing rejection.

Claims 1, 3, 4, 6 through 9 and 11 through 15 stand rejected over the recitation of a solvation delay of “up to a plurality of hours.” Without addressing the merits of the rejection and solely to advance prosecution of the above-referenced case, Claim 1 has been amended to alternatively recite a minimum solvation delay of a few seconds. As noted above, support for this amendment can be found in the Application-as-filed. Accordingly, Applicants respectfully request withdrawal of the foregoing rejection.

The Claimed Invention is Patentable in Light of the Art of Record

Claims 1, 3 through 9, 11 and 12 stand rejected over United States Patent No. 3,072,635 to Menkart et al in light of United States Patent No. 4,366,070 to Block..

It may be useful to briefly consider the invention before addressing the merits of the rejection.

The production of aqueous solutions of cellulose ethers can be problematic. This applies, in particular, when the cellulose ether is present as fine powder having enlarged surface area. If such a cellulose ether powder comes into contact with water, the individual granules swell and clump together to form relatively large agglomerates, the surface of which is thickened in a gel-like manner. However, depending on the mixing intensity, a certain proportion of completely unwetted cellose ether is situated in the interior of these agglomerates. Complete dissolution of

these agglomerates can take up to 24 hours. Crosslinking of cellulose can be beneficial in the dissolution of cellulose ethers, for example by controlling swelling.

Glyoxal has heretofore been known for use in crosslinking cellulose ethers, as clearly evidenced by Menkart. Carbaldehyde groups on the glyoxal react with the hydroxy groups of the cellulose ether to form hemiacetal bonds. Hemiacetal bonds are pH sensitive, and cleave when the cross-linked cellulose ether is stirred into neutral or weakly acidic water, as discussed in the Application-as-filed on Page 2, lines 26 through 30, and as further correctly noted by the Examiner. Such cleavage is problematic because it reintroduces the glyoxal back into solution. Glyoxal, as well as a number of other low-molecular weight cross-linkers, pose a potential health risk. Glyoxal has in recent years been categorized as a mutagen and sensitizing substance, for example.

The challenges associated with the crosslinking of cellulose ethers are further exacerbated by large-scale manufacturing issues. Applicants respectfully reiterate that it is highly problematic to disperse the crosslinker within cellulose ether, for example, as evidenced by Menkart at Col. 3, lines 4 through 6. Menkart addresses the issue through unconventional methods, such as vapor treatments and the like.

It was thus an object of the present invention to develop a method by which cellulose ethers can be reversibly crosslinked and which succeeds without the use of low molecular weight compounds, such as glyoxal, which are set free again when using the crosslinked cellulose ethers, and which further can be used in large-scale industrial production of uniformly crosslinked cellulose ethers. In addition, such methods should not substantially interfere with the beneficial rheology provided by cellulose ethers.

Applicants have found that the use of a mixed functionality cross-linker allows the production of cellulose ether solutions which are readily stirrable and provides a defined solvation delay, without producing small molecules in solution.

Applicants have more particularly determined that reversible cross-linking compounds that further include an acid group produce an ester upon reacting with a hydroxy group on the cellulose ether. The formation of such an ester group was quite surprising to those skilled in the art because the hydroxy group on cellulose ether is not considered readily accessible for cross-linking agents containing carboxy groups.

This ester group is highly beneficial because it remains intact when the cross-linked product is brought into contact with water, as discussed in the Application-as-filed on Page 4, lines 9 through 14. Accordingly, no cross-linking agent (e.g. no low molecular weight compound) is released when the cross-linked cellulose ether is dissolved in water, thereby avoiding a possible health risk.

Altogether unexpectedly, the ester bonded molecule remaining on the reacted cellulose does not interfere with the rheology of the resulting cellulose ether solution.

Accordingly, the claims are directed to methods for producing reversibly crosslinked cellulose ethers comprising initially admixing a cellulose ether composition comprising cellulose ethers having free OH groups in water or in an organic suspension medium with chemical compounds containing at least one aldehyde group and at least one acid group, with the cellulose ether not being dissolved in the water or the suspension medium.

Advantageously, the inventive reversibly crosslinked cellulose ethers are the sole viscosity developer within the resulting aqueous solutions, as recited in the claims as-amended.

In especially advantageous embodiments, the cellulose ether is pre-moistened with either 40 to 80 % water or 30 to 60% organic suspension medium, as recited in Claim 11. Pre-moistening with the recited elevated quantities of water or solvent allows the crosslinking solution to more uniformly penetrate the cellulose mass, thereby providing more uniform properties within the resulting crosslinked cellulose.

In particularly beneficial aqueous aspects of such embodiments, the cellulose ether is pre-moistened with 40 to 80% water, the pre-moistened cellulose is admixed with water and chemical compounds containing at least one aldehyde group and at least one acid group, the admixed cellulose ether composition is comminuted; the comminuted cellulose ether composition is milled and the milled cellulose ether composition is then crosslinked to form an ester or hemiacetal bond, as recited in Claim 14 as-amended. The recited re-moistening with the recited elevated quantities of water in combination with comminuting and milling of the composition prior to crosslinking provides for extremely uniform crosslinking within the resulting crosslinked cellulose.

Particularly advantageous organic-suspension aspects of such embodiments comprise (i) pre-suspending cellulose ether having free OH groups in 30 to 60% organic suspension medium; (ii) admixing the pre-suspended cellulose ether with an organic suspension medium and chemical compounds containing at least one aldehyde group and at least one acid group; (iii) filtering the admixed cellulose ether composition; (iv) drying the filtered cellulose ether composition; (v) comminuting the filtered cellulose ether composition; and (vi) heating the comminuted cellulose ether composition to react the acid groups and aldehyde groups of the chemical compounds with the OH groups of the cellulose ethers to form an ester bond or hemiacetal bond at a temperature ranging from 50 to 105 °C, as recited in Claim 15 as-amended. The recited re-moistening with the recited elevated quantities of organic suspension medium in combination with comminuting of the composition prior to crosslinking likewise provides for extremely uniform crosslinking within the resulting crosslinked cellulose.

Applicants respectfully reiterate that the cited references do not teach or suggest the claimed invention, considered either alone or in combination.

Menkart is merely directed to the conventional use of aldehyde treating agents. (Col. 1, lines 45 – 50). Menkart generally indicates that any of glyoxal, formaldehyde or succinaldehyde may be reacted with cellulose ethers, with glyoxal being preferred. (Col. 1, lines 48 – 50). Menkart teaches that moisture is important for good contact with the treating agent. (Col. 3, lines 4 – 6). Although broadly noting a number of methods, Menkart expressly teaches the use of dilute cellulose ether solutions, such as a 10 % cellulose ether solution in alcohol. (Col. 5, lines 55 – Col. 6, line 4). Menkart alternatively teaches the spraying of glyoxal onto “moist” cellulose particles. Menkart’s “moist” cellulose may contain as little as 10% moisture. (Col. 3, lines 8 – 11 and lines 50 – 55) . Menkart’s working example directed to spray application incorporates cellulose ether containing about 20% moisture, which Menkart specifically blended from a higher moisture cellulose ether and a lower moisture cellulose ether. (Col. 6, line 70 – Col. 7, line 3). Menkart alternatively disclose the combination of glyoxal with the cellulose ether by vapor treatment. (Col. 3, lines 49 – 63). Menkart repeatedly discloses the direct crosslinking of cellulose ether filter cake during a single-step drying. (Col. 3, lines 38 – 43; Ex. 1, Col. 5, line 55 – 67 and Exs. 6 and 7, Col. 7, lines 19 – 42)

Applicants respectfully reiterate that Menkart does not teach or suggest the claimed invention.

Menkart, altogether silent as to agents other than its aldehyde treating agents, does not teach or suggest the inventive methods for producing reversibly-crosslinked cellulose ethers in which cellulose ethers having free OH groups are admixed with chemical compounds containing at least one acid group. Applicants further respectfully reiterate that there would have been no motivation for Menkart to have incorporated the recited chemical compounds containing at least one acid group, as there would have been no expectation of success. As noted above, the formation of such an ester group was quite surprising to those skilled in the art because the

hydroxy group on cellulose ether is not considered readily accessible for cross-linking agents containing carboxy groups.

Applicants further respectfully reiterate that Menkart, altogether silent as to solvation delay, most certainly does not teach or suggest that cellulose ether containing from 0.01 to 0.1 mol per mole of a chemical compound containing at least one aldehyde group and at least one acid group would result in reversibly-crosslinked cellulose ether having a solvation delay of a minimum of a few seconds, as recited in Claim 1 as-amended. In contrast to the urgings of the Office Action, Applicants respectfully submit that Menkart's general reference to the formation of "a clear solution" can not be imputed to mean solvation delay. As noted above, solvation delay is a rheological term of art referring to pause within the viscosity build of a solution. Menkart merely indicates that his celluloses are soluble, but does not teach or suggest the viscosity curve associated with that dissolution.

Menkart further fails to teach or suggest advantageous methods in which cellulose ether is pre-moistened with 40 to 80 % water or 30 to 60% organic suspension medium prior to admixing with water or an organic suspension medium containing a chemical compounds containing at least one aldehyde group and at least one acid group, as recited in Claim 11. As noted within the outstanding Office Action at Page 13, Menkart does notes that cellulose can be "suspended" in solvent. However, Menkart's reference is to solvent that further contains glyoxal, as correctly noted by the Examiner on Page 10 of the outstanding Office Action. As noted within the outstanding Office Action, Menkart alternatively teaches the spraying of glyoxal onto "moist" cellulose particles. Applicants respectfully submit that Menkart's "moist" cellulose may contain as little as 10% moisture. In fact, Menkart teaches away from the use of the recited elevated pre-moistened cellulose ethers by instead teaching in his Example 5 that a higher moisture content cellulose ether should blended with a lower moisture content cellulose ether to provide a modest moisture content prior to glyoxal application.

Menkart, expressly teaching on numerous occasions the cross-linking of filter cake, further fails to teach or suggest the steps of comminuting an admixed cellulose ether composition; milling the comminuted cellulose ether composition; and crosslinking the milled cellulose ether composition, as recited in Claim 14. As correctly noted by the Examiner, Menkart instead expressly teaches pulverization after drying, thus Menkart merely discloses pulverizing the crosslinked cellose. Hence Menkart's pulverization does not impart greater uniformity in crosslinking, but instead merely provides the crosslinked cellulose in a form suitable for further processing. Applicants respectfully submit that the recited steps of comminuting and milling the admixed cellulose ether compositions prior to crosslinking unexpectedly provides a greater uniformity in crosslinking within the resulting cellulose ether which is neither taught nor suggested by Menkart.

And Menkart most certainly does not teach or suggest such advantageous comminuting and milling of compositions prior to crosslinking in combination with the beneficial pre-moistening of the cellulose ether, as recited in Claim 14 as-amended. Such extraordinarily advantageous embodiments, in which the reversible crosslinker is initially more uniformly diffused into and subsequently more uniformly physically distributed within the cellulose ether prior to crosslinking is most certainly not taught or suggested by Menkart.

Menkart thus likewise fails to teach or suggest the steps of pre-suspending cellulose ether in 30 to 60% organic suspension medium, admixing the pre-suspended cellulose ether with suspension medium and crosslinker, commutating the admixed suspension and crosslinking the comminuted cellulose ether composition, as recited in Claim 15 as-amended.

Accordingly, Applicants respectfully submit that the presently claimed method is patentable in light of Menkart, considered either alone or in combination with the remaining art of record.

Applicants respectfully submit that the claimed invention is likewise patentable in light of Block.

Applicants respectfully reiterate that Block is generally directed to improved well drilling fluids. (Col. 1, lines 17 – 20). The drilling fluids of Block include both a crosslinked cellulose and an aluminum compound to impart the desired rheology. (Col. 3, line 42 – 56 and Col. 6, lines 10 – 16). In fact, Block cautions that crosslinked cellulose alone does not impart adequate rheological properties, and thus must be used in combination with an aluminum agent. (Col. 6, lines 31 – 35 and Col. 10, lines 18 - 20). Block goes on to particularly illustrate and discuss within his working examples that the crosslinked cellulose alone does not impart suitable rheology. (Col. 10, lines 9 – 20).

Block indicates that any of a generic laundry list of cellulosic crosslinking agents is suitable. (Col. 5, lines 24 – 55). Block's working examples incorporate glyoxal, paraformaldehyde or epichlorohydrin. (Col. 9, lines 14 – 39). Block merely generically notes that the crosslinked cellulose may be formed by reacting the cellulose ether in an aqueous medium, followed by "conventional" recovery techniques. (Col. 5, line 63 – Col. 6, line 2). The working examples indicate that the "aqueous medium" is a 5 % solution of HEC. (Col. 5, lines 63 – 65 and Col. 9, lines 14 – 35). Conventional recovery techniques include precipitation, filtration and drying. (Col. 5, line 68 – Col. 6, line 2). Block indicates that his compositions are ultimately intended for use at an alkaline pH, such as a pH ranging from 8 to 12. (Col. 8, lines 57 – 60). The working examples indicate that the crosslinked cellulose is adjusted to a pH of 9.6. (Col. 9, lines 21 – 27).

Applicants respectfully reiterate that Block, disclosing dilute solutions of 5 % HEC, does not teach or suggest the claimed methods, in which the cellulose is not dissolved within the water or suspension medium. Block instead treats the HEC in very dilute form and thus the reaction is carried out in a homogeneous system, i.e. the HEC is dissolved in the water.

Block, generically noting a laundry list of crosslinkers and specifically enumerating glyoxal, further does not teach or suggest that beneficial cellulose ether compositions further including chemical compounds containing at least one aldehyde group and at least one acid group would not generate low molecular weight compounds within the aqueous solution upon final dissolution of the cellulose ether, as provided by the claimed methods. Applicants respectfully reiterate that the formation of an irreversible ester group was quite surprising to those skilled in the art because the hydroxy group on cellulose ether is not considered readily accessible for cross-linking agents containing carboxy groups.

Block, similarly silent as to solvation delay, most certainly does not teach or suggest that cellulose ether containing from 0.01 to 0.1 mol per mole of a chemical compound containing at least one aldehyde group and at least one acid group would result in reversibly-crosslinked cellulose ether having a solvation delay of a minimum of a few seconds, as recited in Claim 1 as-amended.

And Block, requiring a combination of aluminum and cellulose to provide adequate rheology, can not teach or suggest aqueous solutions containing reversibly crosslinked cellulose ether as a sole viscosity developer, as recited in the claims as-amended.

Block, incorporating his crosslinked cellulose into alkaline solutions, also can not teach or suggest beneficial aspects in which the chemical compound containing at least one aldehyde group and at least one acid group is not released upon dissolving the reversibly crosslinked cellulose ether in a neutral or weakly acidic aqueous solution, as recited in Claim 12.

Block further fails to teach or suggest advantageous methods in which cellulose ether is pre-moistened with 40 to 80 % water or 30 to 60% organic suspension medium prior to admixing with water or an organic suspension medium containing a chemical compounds containing at least one aldehyde group and at least one acid group, as recited in Claim 11.

Block likewise fails to teach or suggest the steps of comminuting an admixed cellulose ether composition; milling the comminuted cellulose ether composition; and crosslinking the milled cellulose ether composition, as recited in Claim 14. As noted above, Applicants respectfully submit that the recited steps of comminuting and milling the admixed cellulose ether compositions prior to crosslinking unexpectedly provides a greater uniformity in crosslinking within the resulting cellulose ether, which is likewise neither taught nor suggested by Block.

And Block most certainly does not teach or suggest such advantageous comminuting and milling of compositions prior to crosslinking in combination with the beneficial pre-moistening of the cellulose ether, as further recited in Claim 14 as-amended. Such extraordinarily advantageous embodiments, in which the reversible crosslinker is initially more uniformly diffused into and subsequently more uniformly physically distributed within the cellulose ether prior to crosslinking is likewise most certainly not taught or suggested by Block.

Block also similarly fails to teach or suggest the steps of pre-suspending cellulose ether in 30 to 60% organic suspension medium, admixing the pre-suspended cellulose ether with suspension medium and crosslinker, commutating the admixed suspension and crosslinking the comminuted cellulose ether composition, as recited in Claim 15 as-amended.

Accordingly, Applicants respectfully submit that the presently claimed method is patentable in light of Block, considered either alone or in combination with the remaining art of record.

Applicants respectfully submit that there would have been no motivation to have combined Menkart and Block. Menkart is directed to aldehyde treating agents. Block is directed to drilling fluid compositions. These are altogether different fields of endeavor and problems solved, to say the least.

However, even if Applicants had combined Menkart and Block (which they did not), the claimed invention would not result.

The combination does not teach or suggest that beneficial cellulose ether compositions that further include chemical compounds containing at least one aldehyde group and at least one acid group would not generate low molecular weight compounds within the aqueous solution upon final dissolution of the cellulose ether, as provided by the claimed methods.

Nor does the combination teach or suggest that cellulose ether containing from 0.01 to 0.1 mol per mole of a chemical compound containing at least one aldehyde group and at least one acid group would result in reversibly-crosslinked cellulose ether having a solvation delay of a minimum of a few seconds, as recited in Claim 1 as-amended.

And the combination can not teach or suggest aqueous solutions containing reversibly crosslinked cellulose ether as a sole viscosity developer, as recited in the claims as-amended. Block instead strongly teaches away from such compositions.

The combination further fails to teach or suggest advantageous methods in which cellulose ether is pre-moistened with 40 to 80 % water or 30 to 60% organic suspension medium prior to admixing with water or an organic suspension medium containing a chemical compounds containing at least one aldehyde group and at least one acid group, as recited in Claim 11.

And the combination likewise fails to teach or suggest the steps of comminuting an admixed cellulose ether composition; milling the comminuted cellulose ether composition; and crosslinking the milled cellulose ether composition, much less such comminuting and milling in combination with the beneficial pre-moistening of the cellulose ether, as recited in Claim 14 as-amended.

The combination similarly fails to teach or suggest the steps of pre-suspending cellulose ether in 30 to 60% organic suspension medium, admixing the pre-suspended cellulose ether with suspension medium and crosslinker, commutating the admixed suspension and crosslinking the comminuted cellulose ether composition, as recited in Claim 15 as-amended.

Accordingly, Applicants respectfully submit that the claimed invention is patentable in light Menkart and Block, considered either alone or in combination.

CONCLUSION

It is respectfully submitted that Applicants have made a significant and important contribution to the art, which is neither disclosed nor suggested in the art. It is believed that all of pending Claims 1, 4, 6 through 9 and 11, 12, 14 and 15 are now in condition for immediate allowance. It is requested that the Examiner telephone the undersigned if any questions remain to expedite examination of this application.

It is not believed that extensions of time or fees are required, beyond those which may otherwise be provided for in documents accompanying this paper. However, in the event that additional extensions of time and/or fees are necessary to allow consideration of this paper, such extensions are hereby petitioned under 37 CFR § 1.136(a), and any fee required is hereby authorized to be charged to Deposit Account No. 50-2193.

Respectfully submitted,



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Filing Date: February 10, 2005
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I hereby certify that this correspondence is being electronically transmitted to the United States Patent and Trademark Office PAIR electronic filing system in accordance with § 1.6(a)(4) on February 28, 2009.

A handwritten signature in cursive script, reading "Claire Wygand", written over a horizontal line.

Claire Wygand